Australian Curriculum

LINKED LESSONS

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In providing a continued focus on tasks and activities that help to illustrate key ideas embedded in the new Australian Curriculum, this issue we focus on Number in the Number and Algebra strand.

	Number & Algebra	Measurement & Geometry	Statistics & Probability
Understanding			
Fluency			
Reasoning			
Problem Solving			

Content descriptors: Number and place value

Year 1

- Recognise, model, read, write and order numbers to at least 100. Locate these numbers on a number line (ACMNA013).
- Count collections to 100 by partitioning numbers using place value (ACMNA014).

Year 2

- Recognise, model, represent and order numbers to at least 1000 (ACMNA027.)
- Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting (ACMNA028).

Year 3

- Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems (ACMNA053).

Year 4

- Recognise, represent and order numbers to at least tens of thousands (ACMNA072).
- Apply place value to partition, rearrange and regroup numbers to at least tens of thousands to assist calculations and solve problems (ACMNA073).
- Recognise that the place value system can be extended to tenths and hundredths. Make connections between fractions and decimal notation (ACMNA079).

Year 5

- Recognise that the place value system can be extended beyond hundredths (ACMNA104).

Place value is prominent in mathematics curricula and there are few, if any, more important understandings to develop in order to enjoy success with mathematics. In this article the focus will be on a few tried and proven activities to develop place value understanding. These activities are provided for students who have moved through developing understanding through bundling and trading and are ready to look at numbers in their representational and abstract forms.

A little editorial if I may! Please do not assume that your students have had these experiences, it may be necessary to introduce/re-introduce bundling and trading before you attempt any of the following activities. Further, it is really important that the bundling/trading activities have been done with a number of different materials (e.g., pop-sticks, MAB, Unifix blocks, etc.) to make sure that the understandings are being generalised across lots of different materials and not just one.

Numerate

Adapted from *Maths Investigations Through Games: Book 3* (Kirkby & Short, 1991).

Depending on the magnitude of the numbers used, any of these may be appropriate links to the *Australian Curriculum: Mathematics*: ACMNA013, ACMNA027, ACMNA053, ACMNA072, ACMNA073, ACMNA079.

To play this game you need three ten-sided dice. Player A rolls the dice and selects two of the numbers that are showing on the face to create a two digit number that is as close as possible to the target number. If the target is 25 and a three, eight and one are evident, the best alternative is the three and one dice to make 31, which is six away from the target. One and eight as 18 could have been constructed, but this is seven away from 25. Player B then takes a turn and then Player C. At the conclusion of Player C's turn, the person who is closest to the target is declared the winner and their initial is placed in the Winner's box. After all eight rounds the overall winner is the person who won the most rounds.

There are several variations which can be applied to this activity. Firstly the number of dice can be changed to two to take away the extra choice and then to one. Playing with one dice, the students roll the dice and then places the digit in the column of their choice. They then roll the dice for a second time and write in that digit. This places the 'strategising' student in the position of making some considerations regarding probability. A further variation is to play to targets of varying digit length (for example 5 digits, that is, working into the tens of thousands) or incorporating a decimal point.

Target	Player A	Player B	Player C	Winner
25				
82				
18				
39				
53				
67				
84				
20				

Overall winner

Dice digits

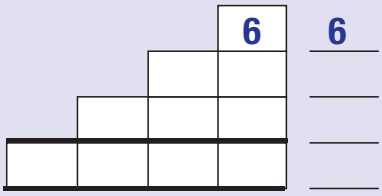
Adapted from Dice Digits *in* Dice Dilemmas *by Paul Swan.*

Depending on the magnitude of the numbers used, any of these may be appropriate links to the *Australian Curriculum*: ACMNA013, ACMNA027, ACMNA053, ACMNA072, ACMNA073, ACMNA079

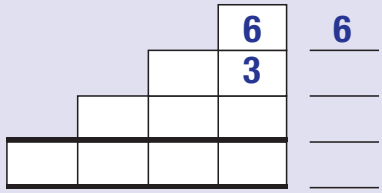
The aim of Dice Digits is to be the player with the smallest total. This game is usually played with a 10-sided dice and initially with the recording sheet. After a while the students can construct their own recording sheets.

I find that students really engage with this game as it has elements of both skill and luck. Parsons (2008) categorises games into three groups: luck, a mixture of luck with skill, and skill. He claims that students quickly disengage with luck games and games of pure skill can result in an inequity which some people may find disengaging, and that the best games are those with a combination of luck and skill.

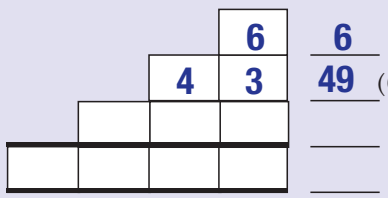
1. I rolled the dice and got a six, on the first line I have no choice. Put the total to the right.



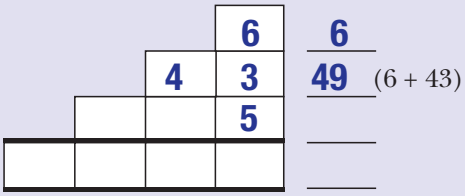
2. I rolled the dice and got a 3. I can place it in either place on the second line. I choose to place it in the ones column.



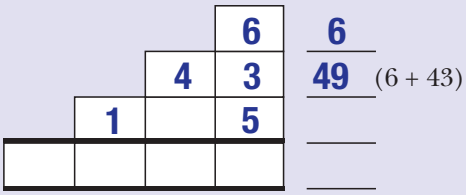
3. I rolled the dice and got a 4 (not what I wanted!). I have to place it in the remaining space on the second line. I put the cumulative total to the right.



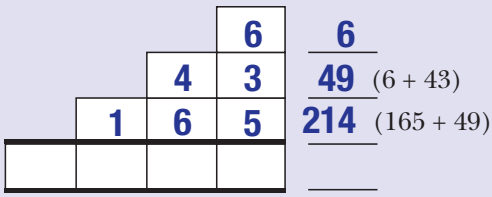
4. I rolled the dice and got a 5. I can place it in any place on the third line. I choose to place it in the ones column.



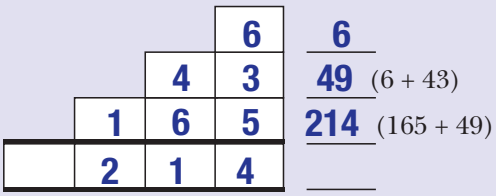
5. I rolled the dice and got a 1 (YES!). I choose to place it in the hundreds column.



6. I rolled the dice and got a 6. I have to place it in the remaining space on the third line. I put the cumulative total to the right.



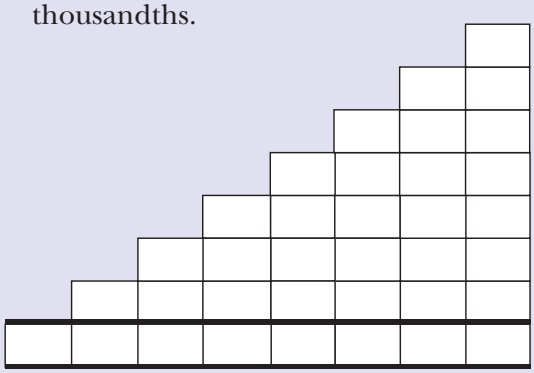
7. I total the columns down to check my addition.



There are a few variations to this game in that:

- you might be playing to create the largest total;
- same number of dice might be used as there are spaces on the line, thereby eliminating the need to delve into the probability of a number being rolled is greater or less than the number already rolled;
- the grid can be changed to accommodate as many digits as you think is appropriate;

- the need for the cumulative totals can be eliminated to concentrate just on the placement of the digits;
- a decimal point may be included to work with tenths, hundredths and thousandths.



This game can be played in small groups but initially I like to play it as a class. By doing it this way, the teacher can interrupt the game at an appropriate time to ask about the reasoning that is behind the placement of a particular digit, and strategies can be offered and discussed. I am often astounded about the level of reasoning that some of the students display and the facility they have to describe that reasoning to their peers, in ways that are credible and understandable.

Calculator wipe-out

Depending on the magnitude of the numbers used, any of these may be appropriate links to the *Australian Curriculum*: ACMNA013, ACMNA014, ACMNA027, ACMNA028, ACMNA053, ACMNA072, ACMNA073, ACMNA079, ACMNA104).

Again, this is an activity that is best served by initially playing it with the whole class. This activity not only strengthens students' capacity with place value, it is also, I think, a good example of how calculators can have a productive role in the mathematics classroom other than finding or checking an answer. The use of the calculator allows the students to concentrate on the place value understanding and not get lost in the calculation.

Enter a number, such as 9256, into the calculator. The nine is there as what I term as an anchor number. Without the nine, if a number is removed from the hundreds place then the zero does not actually appear, and instead there is a blank. Although this is an understanding we want to develop later (a zero on the far left of a whole number has no value), initially it is better for developing the required understandings if the zero is present.

Ask: Using subtraction, how can we make the five a zero? (Subtract 50.) Why did you do that? What number have we got now? Make the two a zero. Make the six a zero.

A requirement is that the students must articulate what they are going to do before they press the buttons, and what number will be gained by removing the digit. This must be expressed as a quantity, not a 'number spelling'; that is, 9056 is 'nine thousand and fifty-six', not 'nine-zero-five-six'.

The variations in this activity can be the introduction of larger number (most calculators will work to eight digits (tens of millions) with whole numbers) or the introduction of a decimal point. When students are familiar with the activity, they can play Calculator Wipe-out in pairs, taking turns to give each other the instructions.

Place value number expanders

Depending on the magnitude of the numbers used, any of these may be appropriate links to the Australian Curriculum: ACMNA013, ACMNA027, ACMNA028, ACMNA053, ACMNA072, ACMNA073, ACMNA079, ACMNA104.

There seems to be three questions students need to be able to answer to be con*sidered confident in* their understanding of place value. These are:

- What's in the … place?
- In what place is the …?
- How many … in the number?

This *place value number expander* (PVNE) has proven to be a valuable tool in helping particularly to develop the second and third of these understandings. The initial construction of these PVNE tends to be the most problematic part and I am aware that commercially produced, laminated copies are available for purchase. However, I have made these with Year 4 students, albeit very

slowly and with lots of assistance to start with, so I know it is possible to do it.

- Cut around one complete strip.

- Fold out the dashed lines and fold in the solid lines.

- Fold together until only the blank (white) areas are showing.

- Write the required digits on these blank areas.

Whilst many students are aware of the first two types of question, some find it difficult even to contemplate, never-mind answering, the third question: "How many … in the number?" For example, if I ask, "How many tens in 364?", many students will answer, "Six". They are confusing this question with "What's in the tens place?" The actual answer is 36, a fact which is illustrated though not explained by opening up the expander. What the expander does is raise the question of why this is the case. I often find that this is then a great opportunity to go back to modelling 364 with MAB materials. Using MAB it is relatively easy to show how the three is actually 300, and that 300 can be traded for 30 tens. By combining these 30 tens with the six tens that are more obvious from 364 (these six actually they sit in the tens place), it can be shown that there are really 36 tens in 364.

These expanders can be used with developing both whole number and decimal-fraction place-value understanding. Although it is conceivable to make the expanders to as many digits as you like, I have found that even for older primary aged children, a 'hundred-thousand' number expander, printed on an A4 landscape piece of paper, is about as much as they can physically handle with any degree of comfort.

Note

There is a rather neat video of Dr Paul Swan demonstrating the use of a PVNE and other place value materials (and materials associated with other mathematics learning) at: www.drpaulswan.com.au/resources/videos/#Place Value.

References

Kirkby, D. & Short, G. (1991). *Maths investigations through games: Book 3.* Melbourne: Longman Cheshire.

Parsons, J. (2008). Mathematical games: Skill + Luck = Learning. *Mathematics Teaching Incorporating Micromath, 209,* 18–21.

Swan, P. (2009). *Dice dilemmas.* Perth, WA: A–Z Type.